RANCH DAY

OCTOBER 9, 1950

New Mexico Experiment Station, New Mexico Extension Service
Southwestern Forest and Range Experiment Station

Ample Grass_____

Productive Cows_____

Heavy Calves_____

Experimental Ranch
New Mexico College of A. and M. A.

Jornada Experimental Range
Southwestern Forest and Range Experimental Station

TENTH ANNUAL RANCH DAY
Jornada Experimental Range and College Ranch
October 9, 1950
Las Cruces, New Mexico
Ivan Watson, New Mexico Extension Service, Presiding

8:00 a.m. Leave Dona Ana Courthouse, Las Cruces, New Mexico

8:40 a.m. Tarbush Clearing. The Jornada Experimental Range and the research program of the Southwestern Forest & Range Experiment Station — C. K. Pearse, Chief, Division of Range Research, Southwestern Forest & Range Experiment Station.

Operation and current conditions on the Jornada Experimental Range — Fred N. Ares, Superintendent.

What we are doing about undesirable range plants — George E. Glendening, Range Conservationist, Southwestern Forest & Range Experiment Station.

9:50 a.m. Pasture 6-Pasture 10 fenceline. Summer grazing of tobosa grass ranges — Fred N. Ares, Superintendent.

Drought in relation to grazing management of semidesert grassland ranges — Hudson G. Reynolds, Range Conservationist, Southwestern Forest & Range Experiment Station.

11:00 a.m. Headquarters - Jornada Experimental Range. Management of the Jornada Experimental Herd, with inspection of cattle. — B. A. Christmas, stockman-cooperator, Jornada Experimental Range.

11:45 a.m. Chuck-wagon lunch. Welcome—Raymond Price, Director, Southwestern Forest & Range Experiment Station, and John W. Branson, President, New Mexico College of Agriculture & Mechanic Arts.

Introduction of Guests

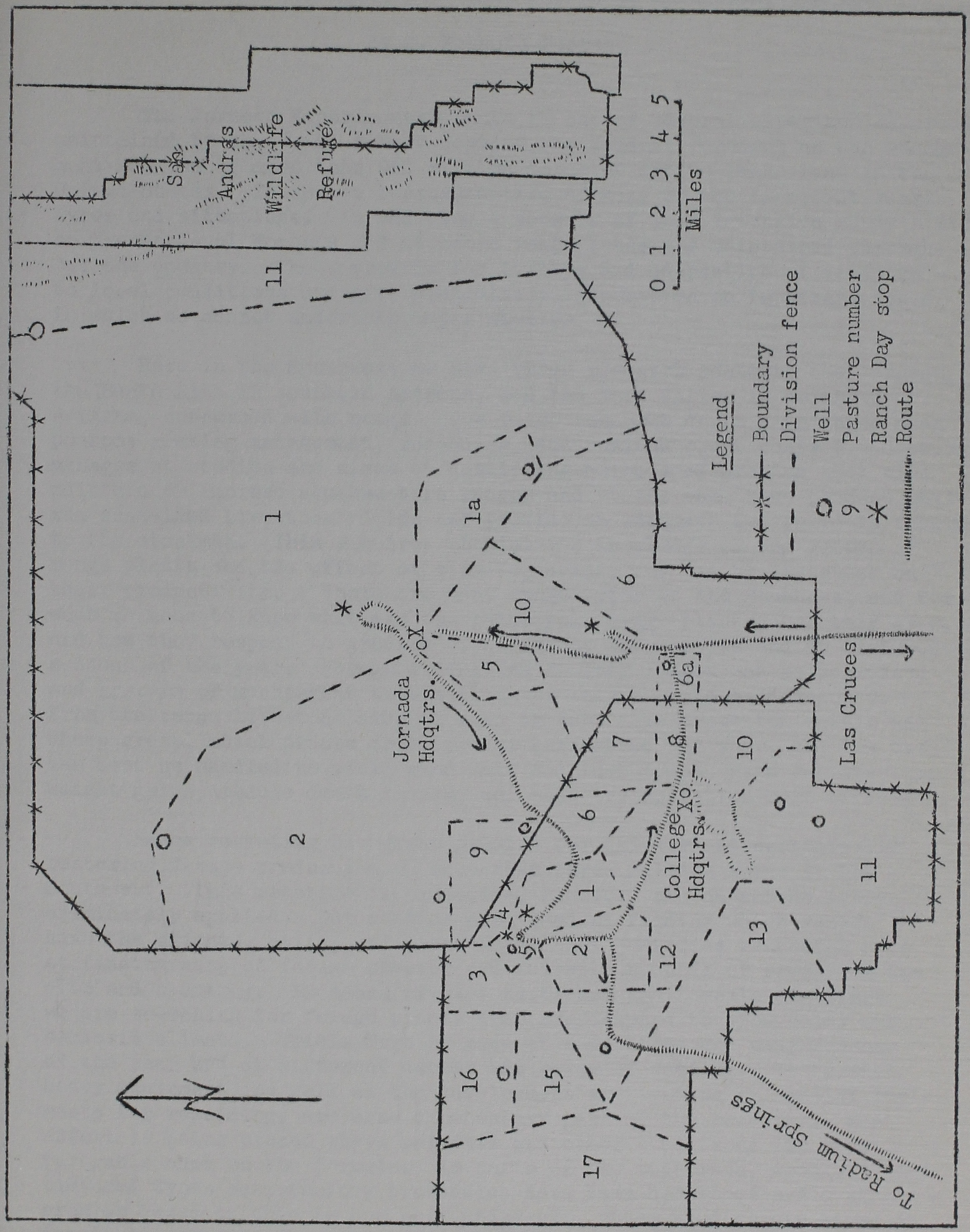
The use of salt in compounding range supplements. Prof. E. B. Stanley, Head, Dept. Animal Husbandry, University of Arizona.

Desert bighorn research at San Andres Refuge—Cecil Kennedy, Fish & Wildlife Service.

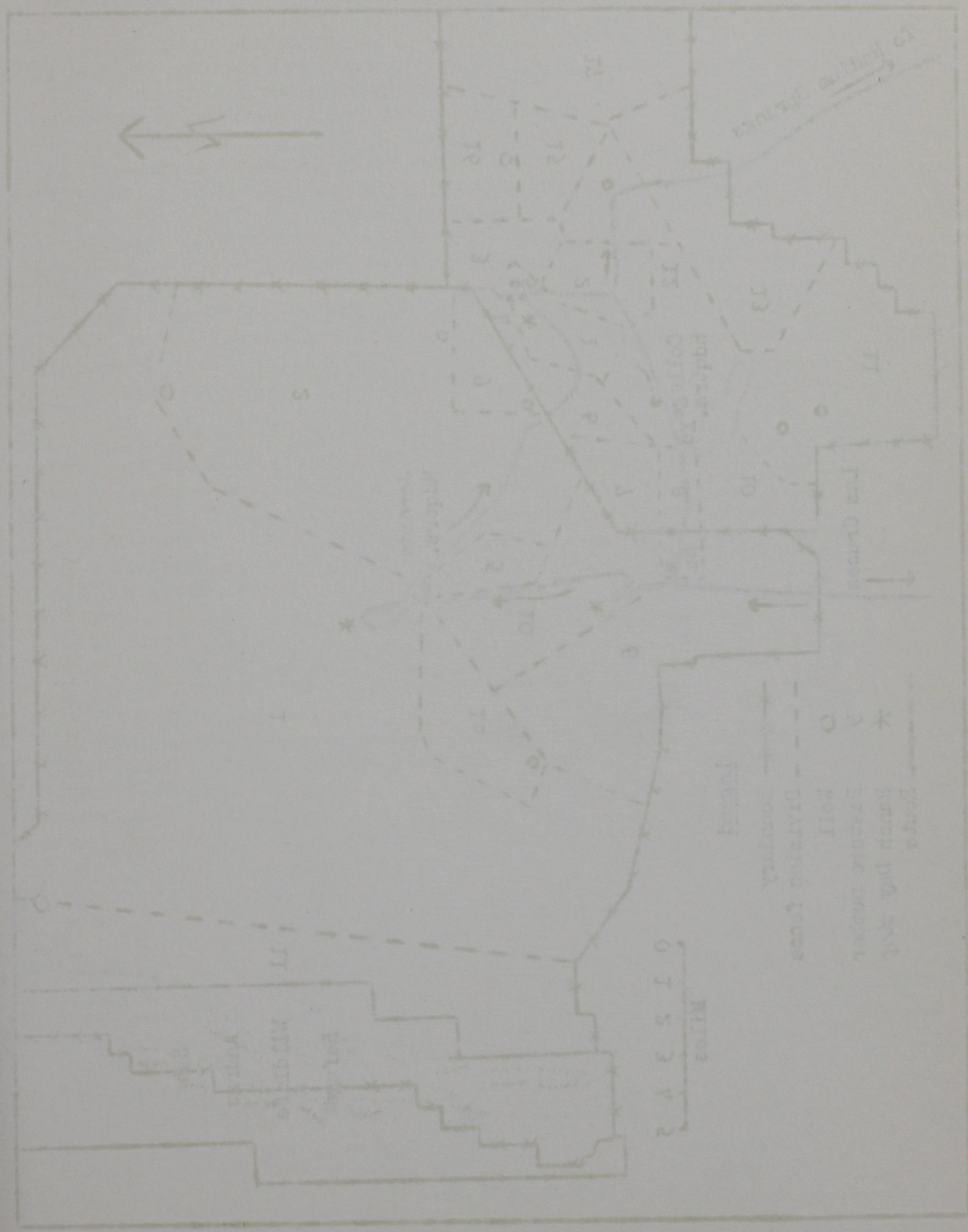
1:40 p.m. Pasture 1. Measuring utilization of a black grama range — C. Kenneth Pearse.

3:00 p.m. College Ranch, Pasture 1. The influence of water distribution on the grazing capacity of rangeland — K. A. Valentine, Associate Animal Husbandman, New Mexico College of Agriculture & Mechanic Arts.

3:45 p.m. Camp Well. The influence of sires on the production of their daughters. Dr. Marvin Koger, Associate Animal Husbandman, New Mexico College of Agriculture & Mechanic Arts.



PORTION OF COLLEGE RANCH AND JORNADA EXPERIMENTAL RANGE
SHOWING RANCH DAY ROUTE



THE JORNADA EXPERIMENTAL RANGE AND THE RANGE RESEARCH PROGRAM OF THE SOUTHWESTERN FOREST AND RANGE EXPERIMENT STATION

By C. Kenneth Pearse

The Jornada Experimental Range is one of several experimental areas, maintained by the U. S. Forest Service, to conduct research on the management and use of more than 960 million acres of native range land in the United States. These are representative of many of the important range types and situations. In addition a network of less intensive study plots on the National Forests and adjacent range lands are maintained throughout the country. These provide for testing and adaptation of findings to local conditions and give preliminary information on important types in which we cannot undertake major studies.

Here in the Southwest we have three research centers, the Jornada, the Santa Rita in southern Arizona, and the Fort Valley in northern Arizona, concerned with range. Our range research deals with three main phases; grazing management, reseeding, and noxious plant control. Grazing management studies are aimed at developing methods of grazing that will maintain or improve southwestern ranges and at the same time produce maximum sustained livestock yields and provide an adequate and reliable return to the stockman. This requires obtaining a knowledge of the growth of range plants and the effect of climate, soils, and use by livestock on their productivity. There are many range types in the Southwest and for each we need to know what are the principal forage plants, how they grow, and how they respond to grazing of different intensities and at different seasons of the year. Forage production on many ranges can be increased and systems of management that will favor this need to be developed. From the range livestock side we need to know more about how cattle and sheep graze, which plants they prefer throughout the year, and how they can best be handled to yield good calf and lamb crops, make satisfactory weight gains, reduce death losses, and make the operation more efficient.

Range reseeding has great promise for quickly and economically restoring forage production on more than three million acres in the Southwest. This practice is expensive, however, and cannot be indiscriminately applied. Our studies are aimed at finding which ranges have the climate, soils, and plant cover that justifies reseeding and at finding adapted forage species and suitable methods of preparing the site and planting. By means of plot tests and small scale plantings we are searching for forage plants that are adapted to grow under our semiarid climate. Trials must be made at many sites and many seasons of the year and at different depths and rates of seeding. Tests with heavy equipment, as well as the development and testing of special implements for reseeding, are also a necessary part of the research. Most effort is being placed where rainfall and other conditions are more favorable than on the Jornada. In parts of the sagebrush, woodland, and timbered types satisfactory procedures have been developed and a planting program based on them is now well underway. Other studies are aimed at developing grazing management practices that will maintain the reseeded stands and insure a continued yield of increased forage from them.

The research on control of noxious range plants has received much emphasis with the growing recognition of the urgent seriousness of noxious plant invasion. Some species have been found easy to control by mechanical or chemical methods. Big sagebrush can be plowed, railed, or burned, if proper procedures are followed, and sand sagebrush can be mowed or sprayed with 2,4-D. Others, and they are among the most aggressive and widespread of the noxious plants, are resistant to most of the treatments so far developed. On these species we will have to learn more about the habits and methods of growth in order to find a weak spot where we can attack successfully and economically. So far our studies of this kind have been concentrated largely on mesquite.

Here on the Jornada, our research has been somewhat curtailed since before the War because of limited finances. The studies are concentrated largely on grazing management and are conducted on a broad practical basis in cooperation with an operating stockman, Mr. B. A. Christmas, who furnishes the experimental cattle. It would take several days to see the Jornada as a whole and consider the many findings obtained. But, that time is not available now. However, during the day we will point out some of our new findings that we think will be of value to you and will give you an opportunity to follow the progress of the work over the past year.

OPERATION AND CURRENT CONDITIONS ON THE JORNADA EXPERIMENTAL RANGE

By Fred N. Ares

Inasmuch as the Ranch Day tour will cover only a small part of the more than 190,000 acres making up the Jornada, it is appropriate at this time that I touch briefly upon the history and nature of the Range and its value as an experimental area.

The Jornada was set aside by executive order of the President in 1912, and in 1915 the Forest Service was assigned responsibility for the experimental work. One of the greatest present values of the Jornada lies in the unbroken series of climatic, vegetative, and correlated livestock records extending over this 35 year period. The Jornada range is considered typical of nearly 30 million acres of the semidesert grasslands of the Southwest. Because of this the area is well suited for use as an experimental area. Whatever is developed and demonstrated here has a wide application elsewhere.

On Ranch Day we have visitors from almost all sections of the Southwest. That means all kinds of grazing lands are represented, high and low altitude ranges, level and rough ranges, brush ranges and grass ranges, or combinations of all these. If anything, most of you probably use land of much higher grazing capacity than that we have to show you today, being more favorably endowed by nature with rainfall. If, however, you have repeated and protracted spells of dry weather, we have much in common with you here on the Jornada.

The experiments on the Jornada are integrated with a practical ranching operation, in order to make our findings most helpful to ranchers. While all land and improvements are owned by the Government, the cattle making up the experimental herd are owned by an individual rancher who is designated the cooperator. Since 1933, Mr. B. A. Christmas has been our cooperator.

The cattle of the experimental herd are handled and grazed according to a plan of management developed in advance. Several phases of this plan of management and the results accruing therefrom will be discussed today at other stops along the route.

The grazing capacity of the usable portions of the Jornada on a yearlong basis is between 1,000 and 1,200 head. The first figure is a minimum stocking rate set up for all except years of severe drought, and periods immediately following,to allow for range recovery. Present stocking is below this minimum because of the continued drought of recent years. In normal years the grazing capacity amounts to about 4 head per section yearlong. This, of course, is the average, some parts having considerably more grazing capacity, others less. In terms of animals grazed, this is about 65 percent of the average forage production. Experience has shown us that if we had stocked on the basis of the average year's forage crop all along we would have been on short rations in over

half of the 35 years from 1915 to 1950. Stocking on the basis of 65 percent of the average forage production safeguards the operator in most years and in a bad drought year necessary reductions can be made without undue sacrifices of the breeding herd. Our work here has shown that once the range stocking on semidesert range is brought into balance with the forage production a lot of the troubles and misfortunes such as high death losses, reduced production of calves, high costs, etc., automatically take care of themselves.

In looking over the Jornada range now as well as at other times of the year you will see in most pastures a considerable amount of old growth remaining from previous years. Don't consider this as wasted feed, but remember that there are two main channels into which each year's forage crop must go. Part will go into the production of livestock, and part will be left as plant food to sustain the life and vigor of the plant and as litter to enrich and protect the soil. The first channel may seem the most important at first glance, but in order to maintain long-time productivity the other one is equally important, just as much so as money in the bank.

Current Range and Forage Conditions

The year 1950 on the Jornada has certainly borne out the rule that drought is normal in the Southwest. The rains of early July broke a dry spell of over 8 months' duration, reaching back to last October. Throughout the fall and winter months there was practically no effective moisture and consequently none of the weed and other annual growth which sometimes helps out so much in late winter and early spring.

Last year's forage crop, while about average in yield, became so dry and unpalatable because of lack of fall and winter moisture and the high winds that it was necessary to feed cattle through the late winter and spring months. This was the second consecutive year when supplemental feeding of the experimental herd was necessary because of the dry quality of the grass. The ration used was the salt-cottonseed meal mixture fed on the open range. This was a very successful operation in both years in that no death losses occurred and calves and yearlings showed a definite increase in weight when sold in the spring.

Of course a plentiful supply of grass forage, even if it is dry and somewhat unpalatable, is essential for efficient use of feed concentrates. This leads us to speculate whether the concentrates render the dry forage more palatable and more easily digested. Observations of grazing use patterns in a feeding experiment using the salt-meal mix with different methods of range feeding seem to point to this.

Perhaps the most striking value of our management practices, including the feeding, is the maintenance of a high rate of natural increase. This year, even after the dry fall and winter, the calf crop on the basis of the present range count will go close to 90 percent. Maintenance of the breeding cows in a thrifty condition by having plenty of forage at all times is largely responsible. The condition of the

animals is one of the things that I hope you will watch for as you traverse the Jornada on this Ranch Day tour. Also, we feel that one of the best criteria of any plan of handling range and livestock, year in and year out, is the rapidity with which range recovers from a severe drought. Keep this in mind as you look at the grass and the cattle on the Jornada Experimental Range and the College Ranch.

WHAT WE ARE DOING ABOUT UNDESIRABLE RANGE PLANTS

By George E. Glendening

Spread of noxious plants a major range management problem

An important problem, which ranchers must face, but one which they do not have to accept is the taking over of grassland areas by woody plants which have little grazing value, or are otherwise objectionable.

The size of this problem is difficult to express in dollars and cents. However, from studies that have been made, it is probable that the spread and increase in stands of juniper, mesquite, cactus, and other worthless woody plants has reduced the grazing capacity on large areas of semidesert and grassland range in Arizona and New Mexico by 50 percent. Texas ranchers are more positive about the cost of noxious plants. They say they are losing 50 million dollars a year because of unwanted woody plants on their ranges.

There isn't time to go into detail about the distribution of all the various species and the problems which they cause. It is important, however, to realize that the over all acreage of noxious plants in the Southwest is tremendous. For example, mesquites now occur on some 17 to 18 million acres in New Mexico and Arizona alone. Including Texas, the figure is nearly 70 million acres.

In central and northern Arizona, central New Mexico, and central and western Texas, ranchers are much concerned about the rapid spread of several different junipers. Junipers now occur on perhaps 45 million acres in the Southwest. Obviously, much of this juniper represents a natural woodland type and should not be confused with areas where juniper is encroaching on grassland ranges.

Some form of cactus is now almost universal throughout the region except on the highest mountain ranges. Cholla is a serious problem in southern Arizona and southern New Mexico, while stands of pricklypear have almost taken over some grassland ranges in eastern New Mexico and Texas. In addition, several noxious plants, including snakeweed, burroweed, shinnery, creosotebush, tarbush, bitterweed, pingue, and others are important locally within the region.

Causes for the increase and spread of these undesirable plants are being investigated, but have not been determined definitely. All of the plants mentioned are native species and we know that the period of their most rapid spread coincides with the period of recent settlement and use by livestock. Spread of seed by livestock and other animals, reduced competition from grasses, and lack of fire no doubt have all entered into the picture.

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Control must be started soon

Regardless of the cause, the important thing is that these woody plants are still spreading and increasing in density to the detriment of forage grasses. Thus, studies by Norris on the College Ranch show that shrubby mesquite is increasing, even in the best grassed areas. The same is true on the Jornada and elsewhere on black grama ranges in southern New Mexico. On some parts of the Santa Rita Experimental Range, typical of much range land in southern Arizona, velvet mesquite has more than doubled during the past 17 years, while cholla cactus has increased 30 to 40 times. Our dry climate will only support just so much vegetation, and we now recognize that on many thousands of acres of potentially productive rangeland stands of unproductive woody plants are so dense, and using so much water, that there is no possible way to increase forage production until these plants are removed. On such areas, removal of the woody plants will increase the production of grass. This relationship is illustrated on the plot where we now stand.

The green shrubs which you see here are tarbush (Flourensia cernua), a plant of no forage value. The tarbush was cleared from a 10-acre area in 1936. Measurements show that the cleared area produced more than 3 times as much grass as the adjacent uncleared area (1080 pounds of green weight per acre as compared with 327 pounds). At the same time the density of the grass was over 4 times as great on the cleared as on the uncleared area.

Release of a remnant grass cover from the competition of mesquite for moisture has a similar effect. For example, data which we have obtained on 4 plots in southern Arizona show that where mesquite was killed in 1945, the average grass production during the period 1945 to 1949 has been nearly 5 times that on adjacent uncleared plots (247 pounds air-dry material per acre as compared with 51 pounds).

There is no longer any doubt that if we are going to continue to make economic use of some of our ranges, controlling these undesirable plants must be made a regular part of range management just like fencing, salting, riding, etc. Since the offending plants seem to be just as well suited to growth on many ranges as the desirable forage species, and tend to reinvade treated areas, it appears that a continuing noxious plant control program will be required. Some ranchers have already begun the fight against the noxious plants on their range.

Methods which are being used

You will be interested in the methods which so far are proving most practical against some of the major plants.

For young mesquites, in the early stages of invasion, nothing will beat a "grubbing hoe." Individual mesquite trees or scattered stands up to 60-80 trees per acre can be effectively controlled by oiling with diesel oil at a cost of 4 cents per tree. In dense stands of mesquite partial control can be obtained by "cabling." Costs as low as 50 cents per acre have been reported for cabling mesquite, but where a followup

treatment is made to remove trees not entirely uprooted, the cost usually runs 5-15 dollars per acre. Also, especially in Texas, much mesquite has been removed by mechanical grubbing with a dozer or "stinger" at costs varying from 5-20 dollars an acre, depending on the number and size of the trees.

On the multiple-stemmed shrubby mesquite such as you will see today, control is more difficult. Spraying with a selective herbicide such as 2,4,5-T appears to offer some hope. Large scale airplane spraying can probably be done for about $2.50 to $3.00 per acre. Consequently, if effective it could have great application on some of the low-value ranges where costs of expensive mechanical treatments cannot be liquidated. Some headway is being made in development of effective methods for spraying mesquite by airplane. This year a series of pilot scale plots were sprayed by airplane in Texas. Recent airplane spray tests on velvet mesquite trees in southern Arizona have given some encouraging results; but we are still producing mainly top kill and are not getting the complete kill which we feel is necessary for practical mesquite control.

One method which any rancher can apply for controlling the further spread of mesquite is to isolate mesquite-infested lands from areas still free of mesquite so as to prevent the transport of seed in the droppings of livestock.

Chemical sprays have so far been ineffective on all junipers. Treatment of basal stems with sodium arsenite, although effective, is time consuming; while oiling the base of a juniper doesn't always produce a kill as it does with mesquite. Consequently, most of the juniper control work done to date has been by mechanical methods. The methods used are based mainly on whether or not the junipers are of the sprouting or non-sprouting variety.

On the non-sprouting species, such as Utah, oneseed, and Ashe juniper, destruction of the tops by chopping at the ground line, lopping of all limbs, or burning will produce a kill. In northern Arizona scattered stands of Utah juniper have been cleared by chopping at a cost of $1.50 per acre. Alligator and redberry juniper, like mesquite, sprout profusely unless destroyed below the soil line. On these sprouting species mechanical uprooting by the use of a bulldozer or a so-called "cedar bit," and cabling are the only effective methods. Cost for dozing stands of juniper depends on abundance and size of the trees and ranges from $3.50 to $15.00 or more per acre. Cost of cabling is much less. For example, on the Fort Apache Indian Reservation cost of cabling on some very suitable sites is reported at less than 75 cents per acre. Hand grubbing of the scattered young trees as soon as they can be seen is an effective and practical method for preventing the invasion of grassland by either the sprouting or non-sprouting forms of juniper.

Pricklypear cactus control was popular in Texas during the 1930's. Over 25 million dollars has been spent. Pricklypear can be killed by spraying with various arsenic compounds, but more recently the trend is toward hand grubbing or prying the plants loose from the ground with a

bar, piling them, and allowing the plants to dry. Some ranchers have hauled the plants off the area. Either system is effective, but is slow and costly.

Some ranchers in eastern New Mexico have cleared cholla cactus from their ranges by pulling them with horse, jeep, or pickup and chain. The eastern New Mexico species of cholla does not break up into joints so readily and the joints don't often take root. Stems of the southern Arizona and New Mexico species of cholla break up easily and the joints take root where they touch mineral soil; and so are not adapted to pulling. In fact, cabling of stands of mesquite and cholla have resulted in great quantities of new cholla.

There is some indication that chemical control of cactus may yet be possible. Limited tests which we have made during the past two years indicate that several sprays which are harmless to people and livestock may be worth trying on both cholla and pricklypear cactus. These include TCA at 1 pound per gallon in water, 2,4-D, and 2,4,5-T at a concentration of 0.75 to 1.0 percent in kerosene. In the latter two cases, the addition of penta-chloro-phenol or dinitro-ortho-secondary-butyl-phenol at 3 and 1 percent, respectively, may give a slightly higher kill. In the case of both pricklypear and cholla the entire plant must be thoroughly covered by the sprayed material if a complete kill is to be obtained.

SUMMER GRAZING OF TOBOSA GRASS RANGES

By Fred N. Ares

On southern New Mexico ranges two major grass types are of primary importance. Tobosa grass is the predominant and most valuable forage species on the clay flats where water collects periodically during the summer. On lighter, well-drained, sandy soils black grama is the desirable species and should provide most of the forage.

Management of livestock should be adapted to maintain these two grasses on the sites to which they are adapted. Tobosa grass ranges, if improperly grazed, deteriorate until they support primarily burrograss with some other low value grasses and weeds. On some potentially good black grama range the black grama has been weakened and killed out and much less valuable species such as dropseed, snakeweed, and threeawns have taken its place. Where black grama and tobosa occur together the range should be managed on the basis of the black grama since it is preferred by cattle for a greater period each year and would be damaged if livestock were managed so as to make fullest use of the tobosa.

One of the principal features of the grazing management plan for the Jornada is seasonal use of the range. The highly valuable and productive black grama range is deferred or very lightly used during the three or four months summer grazing period. Clipping studies and pasture records have shown that such seasonal use is essential to maintain black grama range in good productive condition. During the summer growing season the experimental herd is grazed primarily on the tobosa summer range. These grasses are relished by cattle but only when they are green and succulent and if full value is to be obtained from them they must be grazed before they become dry in the fall.

The black grama pastures on the Jornada that have been deferred produced on the average 460 pounds of forage per acre over the past 10 years. Comparable study areas used yearlong for the past 10 years have produced an average of 211 pounds per acre.

Cattle relish tobosa when it is green. Moreover, frequent cropping during the growing period tends to maintain a supply of tender succulent tobosa forage. Since cattle cannot keep up with the rapid growth during the summer period they return to spots which have been previously grazed and pass over the more mature plants on adjacent areas.

Although it has been demonstrated that seasonal use of black grama and tobosa range is essential from the standpoint of maintaining the two types in most productive condition over the years, this practice has not been uniformly adopted. Some are of the opinion that black grama will put on more pounds of beef at any season of the year and that summer grazing of black grama is desirable for rapid gains, especially on livestock to be marketed in the fall.

To obtain information that would aid in the solution to this problem an experiment was initiated three years ago using two contrasting pastures, 6 and 10. We are in pasture 10 which is primarily a black grama pasture reserved for fall and winter use. Across the fence is pasture 6 which supports primarily tobosa grass valuable for grazing during the summer.

In the study 15 cows with calves and 10 yearlings in each pasture were randomly selected and tagged for weight records. They are weighed before the grazing commences and again at the end of the period and are handled alike throughout the grazing season.

During the first year of the study rainfall was so much more favorable in one pasture than in the other that no comparison of weight gains could be justified. In the second summer grazing season no forage was produced because of the drought. The cattle subsisted on the previous season's forage crop. Last year the rainfall during the summer grazing season was comparable in the two pastures (figure 1). The greatest amount of rain fell during the month of July, which is natural for this region. The rainfall dropped to below one inch during August, but in September it was over one and one-half inches.

The weight gains of the three classes of cattle used in the experiment show a slight advantage for the tobosa pasture during the summer grazing season (figure 2). Cattle made an 11.3 percent greater average gain, representing 17 pounds of beef per head, on tobosa than on black grama. The cows showed the widest difference in amount of gain; those in pasture 6 gaining 26.5 percent more than those in pasture 10. This difference cannot be attributed to the cows in pasture 6 being thinner at the beginning of the experiment. They actually averaged 7 pounds heavier.

Chemical analyses show that protein content is high and fiber is low in both black grama and tobosa when they are green (figure 3). As the grasses mature and become weathered the protein content decreases while the proportion of fiber increases. While the minimum protein requirement for beef cattle varies with many factors, available information indicates that it is about 5 percent for maintaining wet cows and somewhat higher for producing normal growth on yearlings under 600 pounds in weight. Both of the grasses, therefore, have sufficient protein during the growing season, but black grama retains the minimum protein level longer. Tobosa, when in the weathered condition, is clearly deficient in protein. Black grama on the other hand, provides adequate protein in the ration at least for maintenance for most classes of animals for most of the year.

This study has not yet been completed, and our conclusions to date must be tentative. So far, however, indications are that summer grazing of tobosa ranges is desirable from the standpoint of the cattle as well as the range.

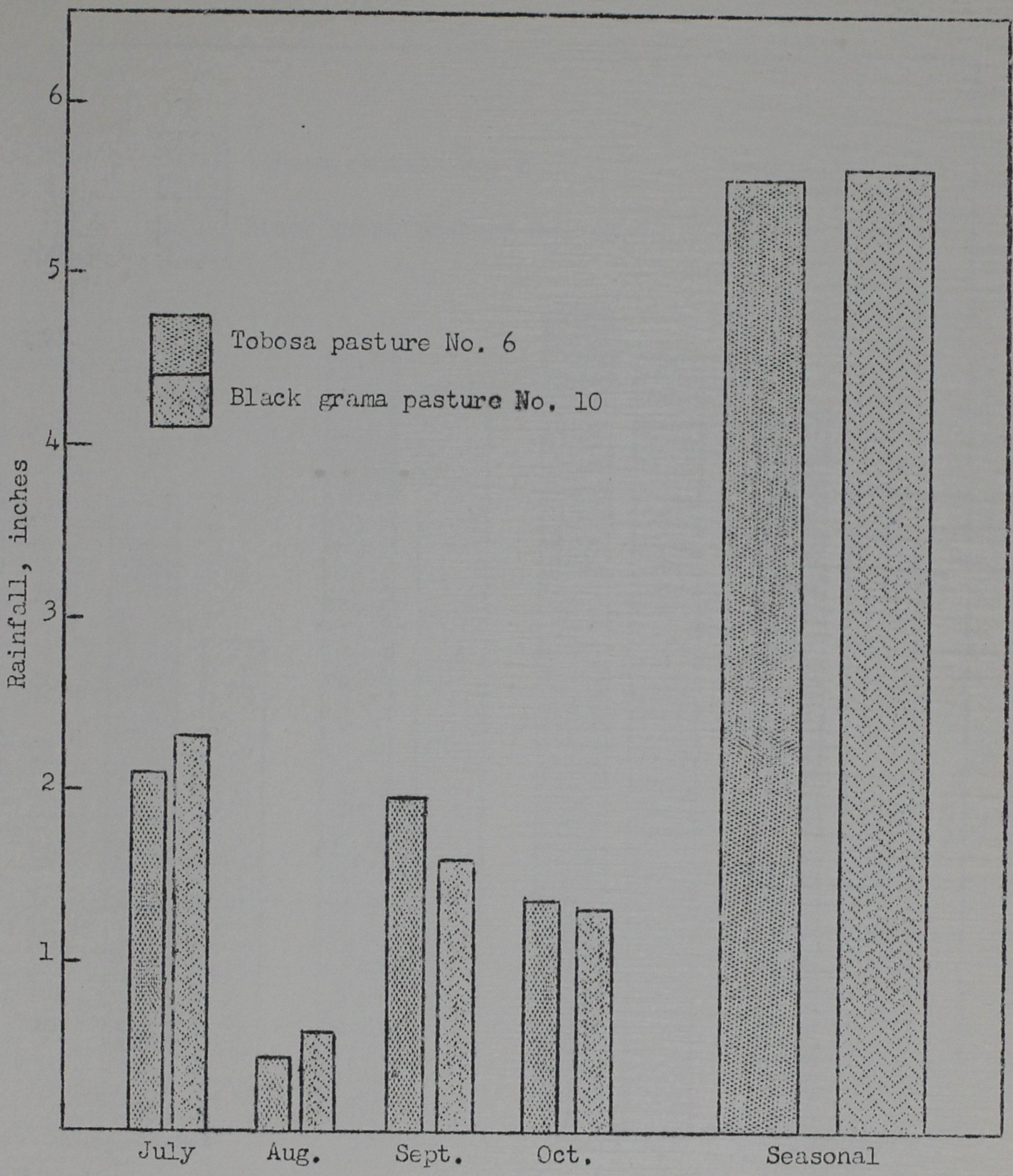


Figure 1.--Monthly and summer seasonal rainfall on tobosa and black grama pastures, Jornada Experimental Range, 1949.

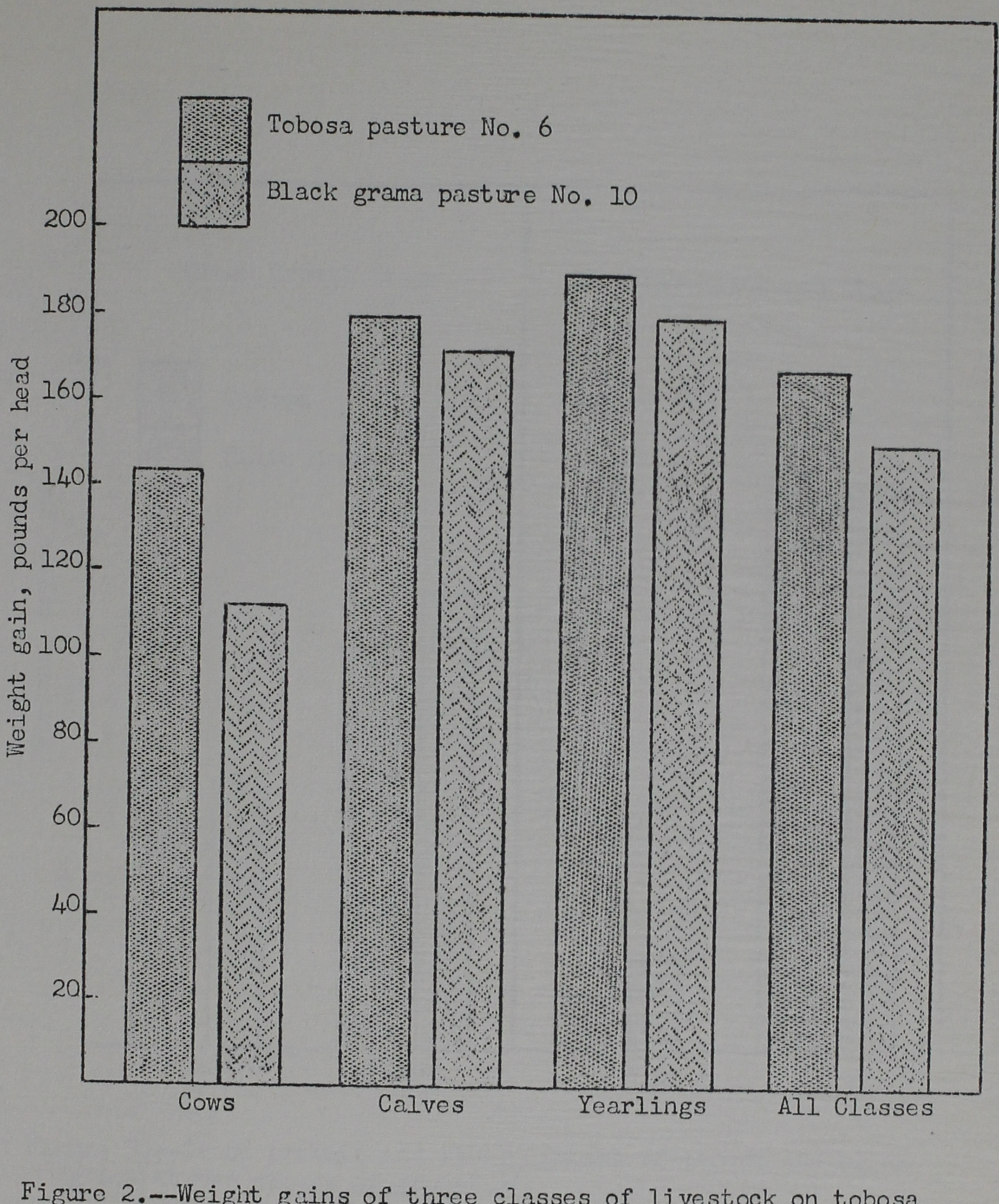


Figure 2.--Weight gains of three classes of livestock on tobosa and black grama pastures, Jornada Experimental Range, from July 18 to November 4, 1949.

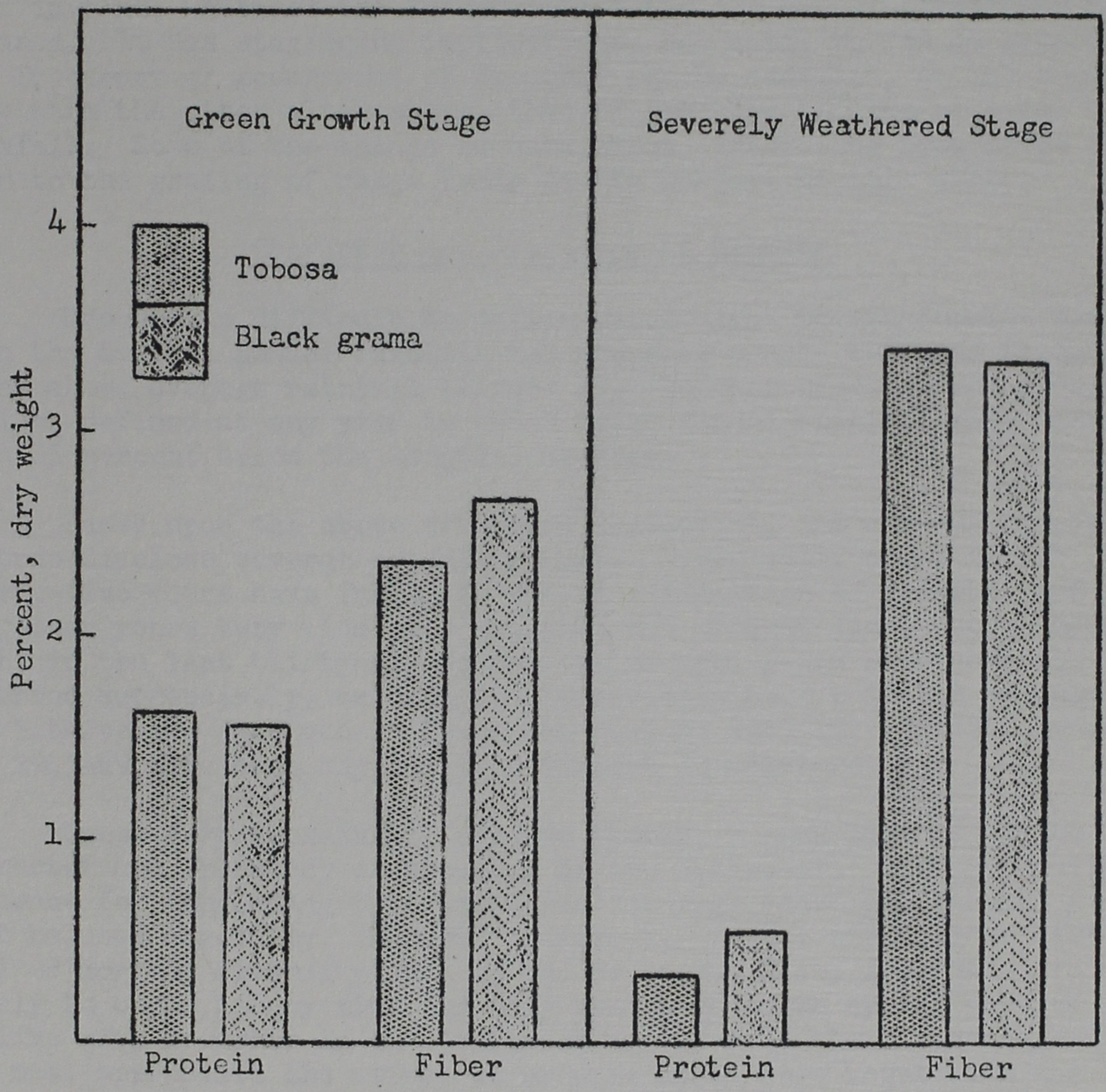
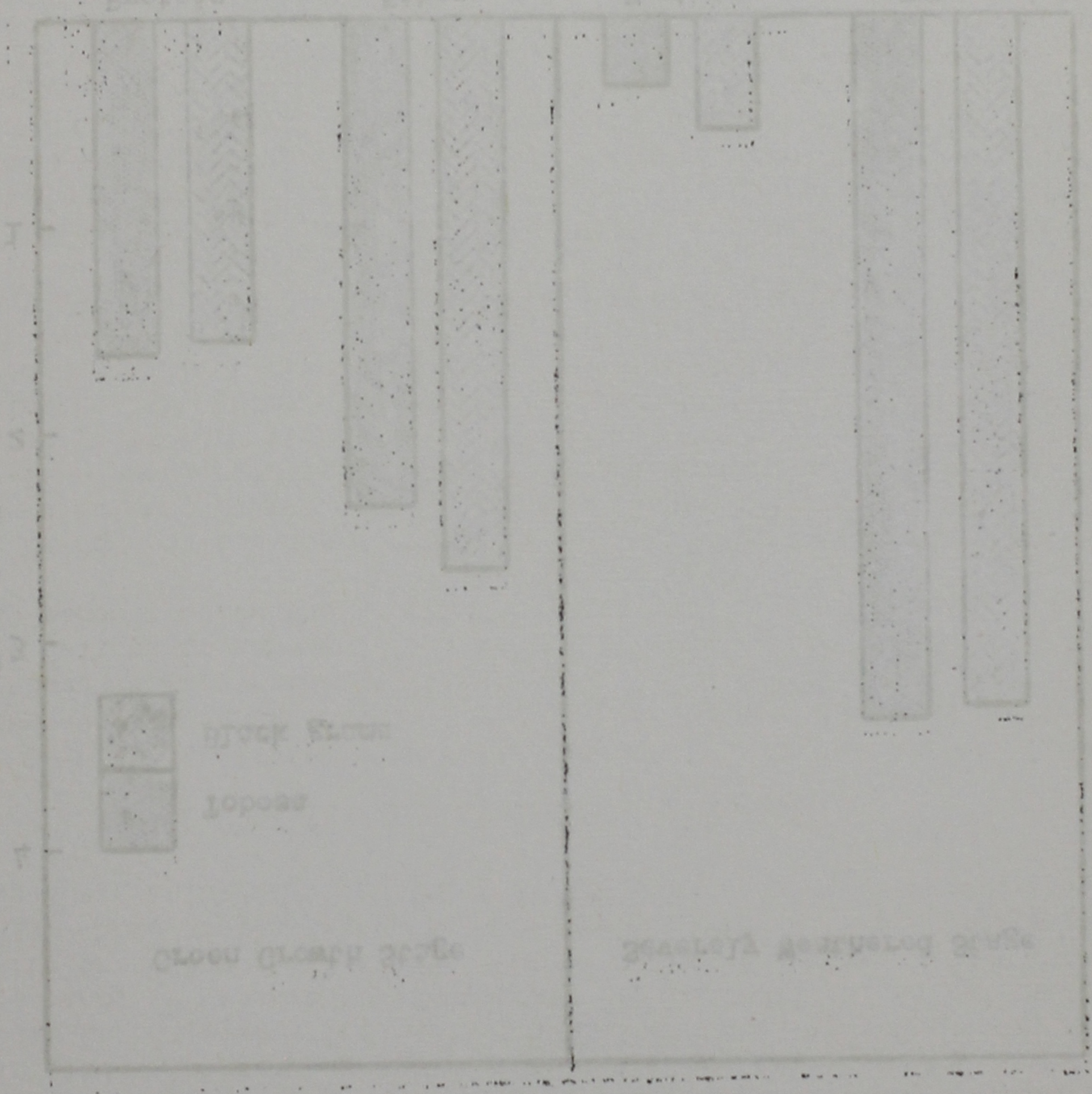


Figure 3.--Crude protein and fiber content of tobosa and black grama at two stages of growth.1/

1/Data supplied through courtesy of Professor W. E. Watkins, New Mexico College of Agriculture and Mechanic Arts.



DROUGHT IN RELATION TO GRAZING MANAGEMENT OF SEMIDESERT GRASSLAND RANGES

By Hudson G. Reynolds

Weather, particularly drought, is a fitting subject for discussion with southwestern stockmen at any time. The good years largely take care of themselves. It is the drought years which must be continually kept in mind. Witness the interest that the new art of rainmaking has aroused. It has staggering implications, but until we can be sure that the frequency or occurrence of droughts can be modified, we had best stay with the other alternative, that of learning to live with our natural rainfall. Some of the things we know about living with drought in relation to the grazing of range lands is the subject of this paper.

Character and Frequency of Drought

Drought is difficult to define precisely. On the Jornada less than the average annual rainfall has occurred almost twice as frequently as above average rainfall (figure 1). In this discussion a drought will be defined as any year in which total annual rainfall falls more than 25 percent below the longtime average.

Based upon the above arbitrary definition, the Jornada rainfall records disclose several notable points. Since 1915, eight of the thirty-five years have fallen in the classification of drought, and two other years very closely approached the drought line. More important, in the last thirty-five years two drought years have commonly occurred successively, or drought periods have been relieved by only one intervening good year. Thus, the periods 1917-18, 1924-25, 1934-36, and 1945-49 have been especially deficient in moisture.

These Jornada rainfall records provide a good picture of the character and frequency of droughts in the Southwest. They are sufficient evidence for concluding that the terms "average year" and "normal year" must be used carefully. Drought is normal. Annual rainfall is characterized more by diversity than by the average. Also, drought years are likely to occur at any time and they follow no known cyclic pattern. To live with droughts in the Southwest and stay in the livestock business, man must appreciate the effect of drought upon range vegetation and livestock, and plan continually to moderate and to relieve the influence of drought.

Effect of Drought on Range Vegetation

It is widely recognized that less forage is produced during dry than wet years. Certain quantitative relations must, however, be appreciated before grazing management procedures can be developed to avoid the serious effects of drought. What is the relation between forage production and amount of rainfall? What is the effect of drought upon plant survival? How long does the effect of drought upon forage plants last? How does grazing during a drought period influence range vegetation? All of these questions have not been completely answered. Certain experimental findings do, however, give a sound basis for grazing management procedures.

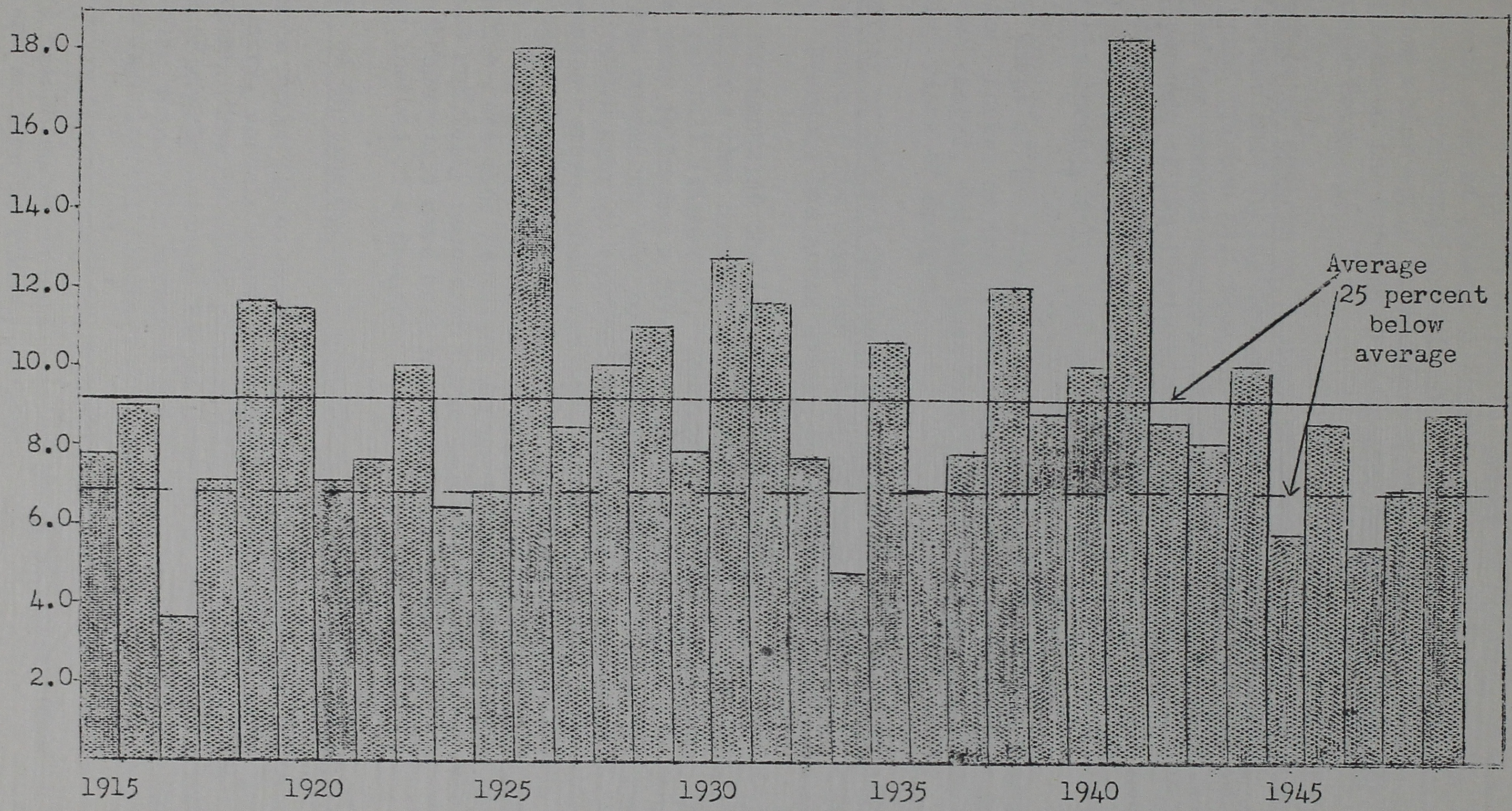


Figure 1.--Annual rainfall on the Jornada Experimental Range showing frequency and duration of drought periods (average of 23 locations).

A number of studies to relate amount of rainfall to density and herbage production of perennial grasses have been made by the Southwestern Forest and Range Experiment Station. Findings of particular interest and which apply to southern New Mexico range lands have been obtained both on the Jornada Experimental Range and on the Santa Rita Experimental Range. 1/

Effect of drought on herbage production.—In general, herbage production declines during drought years and increases during above average years (figure 2). Most of this response is related to the rainfall of the current summer. Statistical analysis suggests that about 45 percent of the fluctuation in annual herbage production is associated with the amount of rainfall during the current summer. About 20 percent of the response is correlated with precipitation of the previous spring, fall, and winter.

On parts of the Jornada, better rains of this summer have resulted in much more forage on the ground than there was a year ago. On many of your own ranges, you may have more forage this year than in the last two to five years of drought.

Effect of drought on plant density.—Ground cover or density is a rough measure of the size and number of plants present on a particular area. Everyone has noted plants dying during a prolonged drought.

Measurements of the effect of rainfall upon density of perennial grasses indicate that density changes lag one year behind changes in amount of rainfall (figure 2). Decreases in density are not apparent until the year following a drought. Of more importance from the standpoint of the permanent well being of the range, at least two years of average or above average rainfall are required before drought weakened forage grasses recover their density. Some ranchers testify that they see more range feed this year than in any of the past 10 years. This is true in many places where, as a result of good rainfall, such plants as were alive have made excellent forage growth. However, these same ranges have not fully recovered their density, and there is not as much forage as there would have been had the previous rainfall year been up to average instead of a drought.

Effect of Grazing During a Drought on Density and Herbage Losses

Since range plants must be grazed to maintain the range livestock industry, certain questions regarding the relationship are of no little import. How is plant productivity affected by grazing? And what kind of grazing reduced forage production the least? These questions have not been completely answered for Southwestern ranges. Some evidence based upon experimental findings does serve as important guides.

1/A branch research unit located about 35 miles south of the headquarters station in Tucson, Arizona.

During the previously mentioned study, the top growth of grama grasses was removed at periodic intervals by clipping. Although this procedure is not exactly comparable to the effect that grazing has upon plants, it does show the influence of top removal upon forage production during drought. Over the nine year study period, plants from which top growth was removed weekly during the summer produced on the average less than one-half as much as plants harvested once at the end of the growing season. During drought years, the frequently harvested plants yielded about as much as those clipped only once, but they did not respond as well to the occasional high rainfall year. Evidently frequent removal of herbage as would occur under heavy grazing has a relatively greater influence on forage production during good rainfall years than during drought years. In time of severe drought, loss of density and reduced forage growth cannot be avoided, and livestock husbandry to prevent production losses appears to be the important consideration.

What Can be Done About Drought?

The fact that both recurrent drought and grazing that is not carefully and wisely managed lower forage productivity makes earning a living from range livestock in the Southwest a hazardous and difficult occupation. But it is not impossible. A number of important lessons have been learned about how to manage ranges to minimize the effects of drought. No one practice is universally applicable. Differences in range situations and in the abilities and imaginations of individual ranchmen have produced a number of different systems. The important test of any grazing system is whether it works over a prolonged period of time.

Some of you may be interested in the grazing practices which have been helpful in maintaining forage productivity on the Jornada Experimental Range. Most important has been the practice of holding stocking to the point where there is enough forage to meet livestock requirements at all times, except for the drought of exceptional intensity or duration (figure 3).

Basing the average rate of stocking of the Jornada Experimental Range on 65 percent of average forage production provides sufficient forage for livestock requirements in 8 out of 10 years. Such a conservative rate of stocking permits a carry-over or reserve of forage on average years that is invaluable in the drought years. When the exceptional drought occurs, further herd reductions are made. This is accomplished by maintaining a flexible herd.

On the Jornada, herd flexibility is attained by keeping the breeding cow numbers down to only 50 to 60 percent of the average grazing capacity (figure 3). Most of the balance is made up of growing steers and heifers. During the period 1938-47, when this type of herd composition was maintained, calf crops averaged 83.5 percent as compared with 74.6 percent during the previous periods when the herd was made up of 70 percent breeding cows. Even when the stocking was somewhat reduced, the amount of beef marketed has been maintained, and

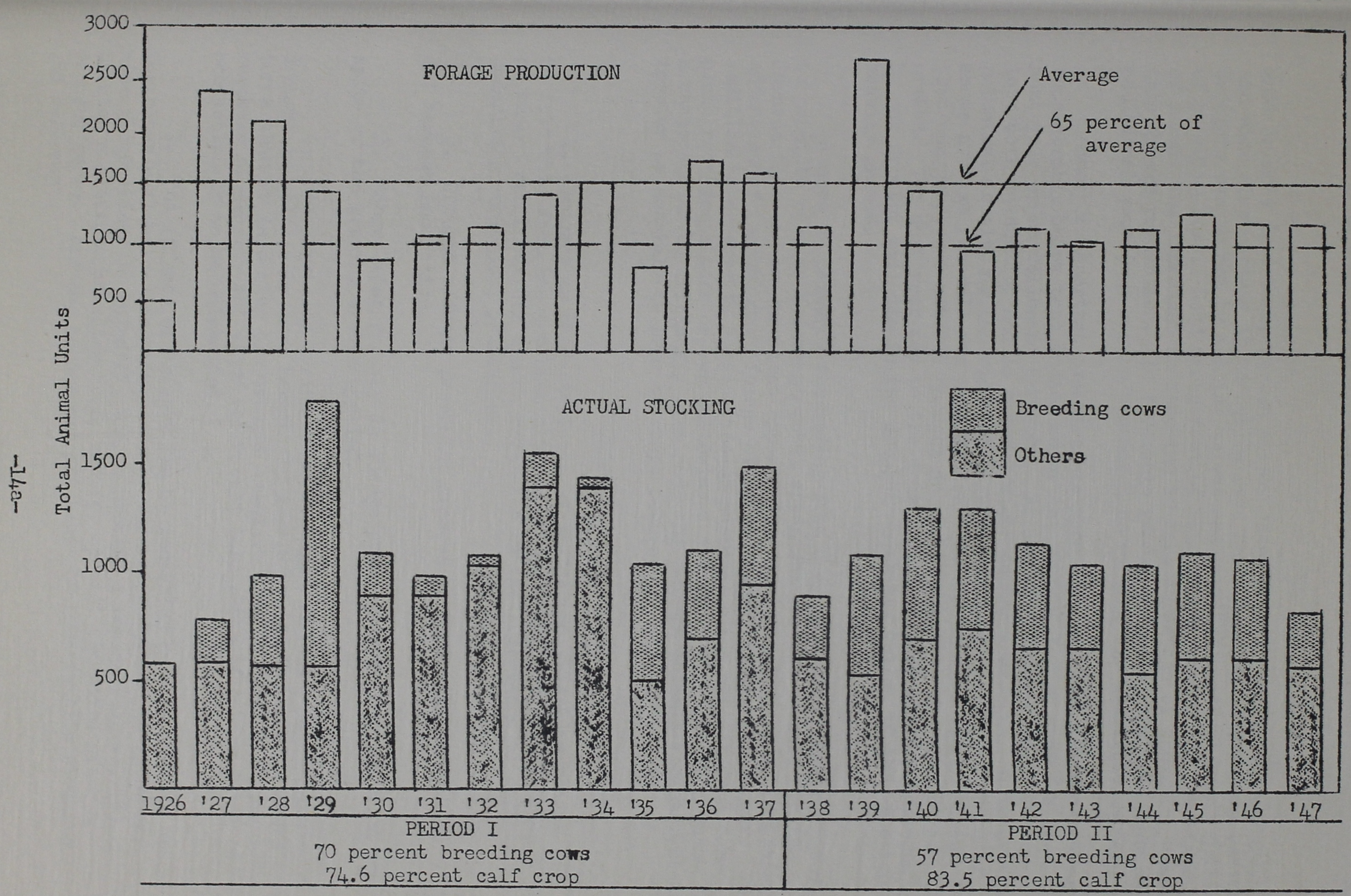


Figure 3.--Forage production and stocking rates on the Jornada Experimental Range for two conditions of herd management.

what is more important, forced sales, sacrifices in the breeding herd, and wide fluctuations in marketing have been avoided. Moderately severe droughts can be met by selling calves and yearlings without undue culling of breeding cows. Herd management of this kind also has the advantage of permitting increases in stocking to take advantage of unusually favorable forage production. In favorable years, calves may be held over and additional yearlings may be purchased to consume the available forage.

Another important practice has been that of maintaining stocking considerably below that indicated by the current forage crop for the next year or so following a drought. As indicated previously, plants lose both in density and in natural vigor during a drought. Neither the potential density nor the vigor is regained until at least two years of above average rainfall are experienced. It should also be remembered that one good year after a drought does not mean that the drought is broken. The next year may be the driest yet. Plants already weakened by one drought will die in the drought which may follow if they are too heavily grazed.

Ranges or pastures recovering from a drought also respond markedly to complete rest or deferment until after the growing season. On the Jornada there is an excellent opportunity for deferring ranges by taking advantage of the abundant forage of tobosa ranges during the summer. In addition to deferment, local sites or pastures often benefit from complete rest for a year or two following a drought. After every drought a range should be critically examined; and grazing animals redistributed insofar as possible to promote range recovery.

Summary

1. Drought is characteristic of semidesert grassland ranges and to date this fact has not been altered by man. The effects of drought on ranges and livestock can be moderated by the observance of certain underlying ecological principles.

2. Drought affects perennial grasses by seriously reducing density and herbage production.

3. Ranges lose greatly in forage production during a drought in spite of the grazing system applied.

4. Heavy grazing during above average rainfall years following a drought is relatively more harmful to forage production and livestock returns than it is during the drought itself. This is because it prevents recovery of density and vigor which must take place if a high level of production is to be maintained.

5. The effects of drought can be moderated by: (a) Keeping stocking rates well below long-time average forage production to allow for wide fluctuations in rainfall, and to provide a forage reserve, (b) maintaining a flexible breeding herd, and (c) special attention after a drought to such grazing management practices as conservative stocking and deferment.

MEASURING UTILIZATION OF A BLACK GRAMA RANGE

By C. Kenneth Pearse

It is good for us who are concerned with range and range livestock to reflect occasionally that our living comes from the land. Just as the farmer is closer to the land than the city dweller, so the stockman is more directly dependent upon the gifts of nature than is the farmer.

Doubtless this closeness to the land has aided the stockman in developing his philosophy of living--to explain to his own satisfaction how he and his cattle and the grass on which they graze all fit into a larger picture. Perhaps the forage grasses have been made to grow on our ranges to provide sustenance for man's livestock. Or perhaps the principal aim in life of a grass plant is to grow vigorously so that it can produce abundant seed and perpetuate itself.

In either case our continued existence and prosperity on these western ranges must be based on use of the grass herbage without impairment of the productive capacity of the range. More broadly interpreted, this means that the use that we make of the herbage must be adjusted so that it will maintain the soil and be harmoniously integrated with other uses of natural resources. A number of southwestern stockmen have grown up on the ranch operated by a pioneer father or grandfather and they in turn hope to leave the outfit unimpaired or even improved to a son or daughter.

Grazing the forage crop in such a way that the resources will be maintained involves many factors: The season of the year when cattle are turned into the range, the frequency of harvesting, and possibly most important, the intensity of grazing.

The question of how much grazing a given range can stand has been the subject of much study. It is just as important for the stockman to know how much grass he has left at the end of the grazing season as to know his bank balance. Over the years certain guides or standards for measuring the degree of use have been developed. As early as 1924, based largely on studies made here on the Jornada, some of the indicators of a properly used range were pointed out. Even then, it was stated that it was easier for the range examiner to recognize a range that was properly used on the ground than to describe its appearance in words that could be understood by others.

The need to bring range use into sharper focus led to the development of "proper use standards" for individual grasses and other forage plants. The fundamental concepts underlying this system included the selection of the more valuable and important species in each range type to serve as "key species" or "indicators" for use in that type. Attention could then be focused on these "key species" and use of the range as a whole judged on the use that had been made of them. Associated species could be used as fully as possible so long as the "indicator plants"

were not over-used. It was found as a result of these studies that due to the growth form of our grasses, most of the weight or volume of herbage is in the basal portion of the plant. Thus, for many grasses, when grazing has removed 80 percent of the height, somewhat less than 50 percent of the total volume has been taken. Recognition of this fact is essential in judging range utilization. Otherwise, an observer who looks mainly at height growth would over-estimate the degree of use or actual weight of herbage removed.

Based on long-time studies and continued observations, guides for proper use of many species were formulated (table 1). These brought out the fact that various species could be grazed more closely than others. It was also shown that the maximum allowable use was less on loose, easily eroded soils and steep slopes than where soils were more stable. To promote range improvement, intensity of use should be less on deteriorated ranges than on ranges in good condition. On black grama ranges with loose soils, such as this, the studies showed that proper use was attained when an average of 40 percent of the total volume or weight of herbage had been removed. This means, for plants of average height, 75 to 80 percent of the height growth is removed. Furthermore, about one-fourth of the seed stalks should remain ungrazed. Such "proper use guides," together with various scales and devices for measuring the plants on the range have proven very helpful. They have been used by National Forest Administration, by the PMA program, and are an essential part of our research.

In a somewhat different approach to the problem of measuring utilization it was decided that since the cow was doing the actual grazing it would be well to study her habits and try to look at range utilization through her eyes. Many observations of cattle grazing have been made. Following are some of the conclusions that have been reached from observations made on several types of grassland ranges in the Southwest:

1. Cows show some definite tendencies in their grazing habits. Individuals differ in their preferences and follow no hard and fast rules so precise predictions are difficult. Nevertheless, important generalizations can be stated accurately.

2. Cattle prefer certain species above others and this preference varies with time of year, time of day, availability of other forage, past grazing experience and other factors.

3. Even within a given species of grass cattle seem to select certain individual plants. We do not know why this is so but the tendency is frequently very marked. One plant may be grazed closely early in the season while its neighbor will escape grazing completely until forage is nearly exhausted.

4. Under moderate grazing each individual plant is usually grazed only once. With the first bite the cow takes a major portion of the plant and the bulk of her diet is obtained from other plants unless forage is too scarce.

Table 1.—A general guide to satisfactory proper use of southwestern range grasses

Common name	Scientific name	Range in good condition			Range deteriorated or steep slopes		
		Crop height	Stubble height	Proper use factor or permissible 1/ volume removal	Stubble height		Proper use factor or permissible 1/ volume removal
		In.	In.	Pct.	In.		Pct.
Bluestem wheatgrass	Agropyron smithi	15	3½	55	5		40
Silver beardgrass	Andropogon saccharoides	19	6	40	8½		30
Poverty threeawn	Aristida divaricata	16	4	50	5½		40
Santa Rita threeawn	Aristida glabrata	8	2	50	3		40
Red threeawn	Aristida longiseta	9	2	40	3		30
Pine dropseed	Blepharoneuron tricholepis	22	2½	50	3½		30
Sprucetop grama	Bouteloua chondrosioides	12	2	40	2½		30
Sideoats grama	Bouteloua curtipendula	19	4	45	6		30
Black grama	Bouteloua eriopoda	19	4-3	40-50 2/	5		30
Slender grama	Bouteloua filiformis	9	2	50	2½		40
Blue grama	Bouteloua gracilis	19	3-2	40-50 3/	4		30
Hairy grama	Bouteloua hirsuta	10	3-2	40-50 3/	4		30
Rothrock grama	Bouteloua rothrocki	12	3	55	4		40
Arizona fescue	Festuca arizonica	13	6	25	8½		15
Tanglehead	Heteropogon contortus	16	6	40	7½		30
Curlymesquite	Hilaria belangeri	10	1½	40	2½		20
Galleta	Hilaria jamesi	19	3	40	4		30
Tobosa	Hilaria mutica	20	4	30	6		15
Junegrass	Koleria cristata	14	2	40	3		30
Wolftail	Lucurus phleoides	11	2½	40	3½		30
Deergrass	Muhlenbergia rigens	25	6	30	7½		20
Bullgrass	Muhlenbergia emersleyi						
Mountain muhly	Muhlenbergia montana	17	4	30	8		15
Bush muhly	Muhlenbergia porteri	14	6	35	7		25
Kentucky bluegrass	Poa pratensis		1½	50			40
Burrograss	Scleropogon brevifolius	6	3	20	4½		5
Squirreltail	Sitanion hystrix	12	4	40	5		30
Alkali sacaton	Sporobolus airoides	30	3½	35	5½		20
Spike dropseed	Sporobolus contractus	26	6	35	9		20
Sand dropseed	Sporobolus cryptandrus						
Black dropseed	Sporobolus interruptus			40			25
N.Mex.feathergrass	Stipa neomexicana	20	3	30	4		20
Arizona cottongrass	Trichachne californica	18	5	40	6		30

1/ On volume-weight basis. 2/ Loose soil: 40; hard soil: 50.

3/ Arizona and the western 2/3 of New Mexico: 40; plains country of eastern New Mexico: 50.

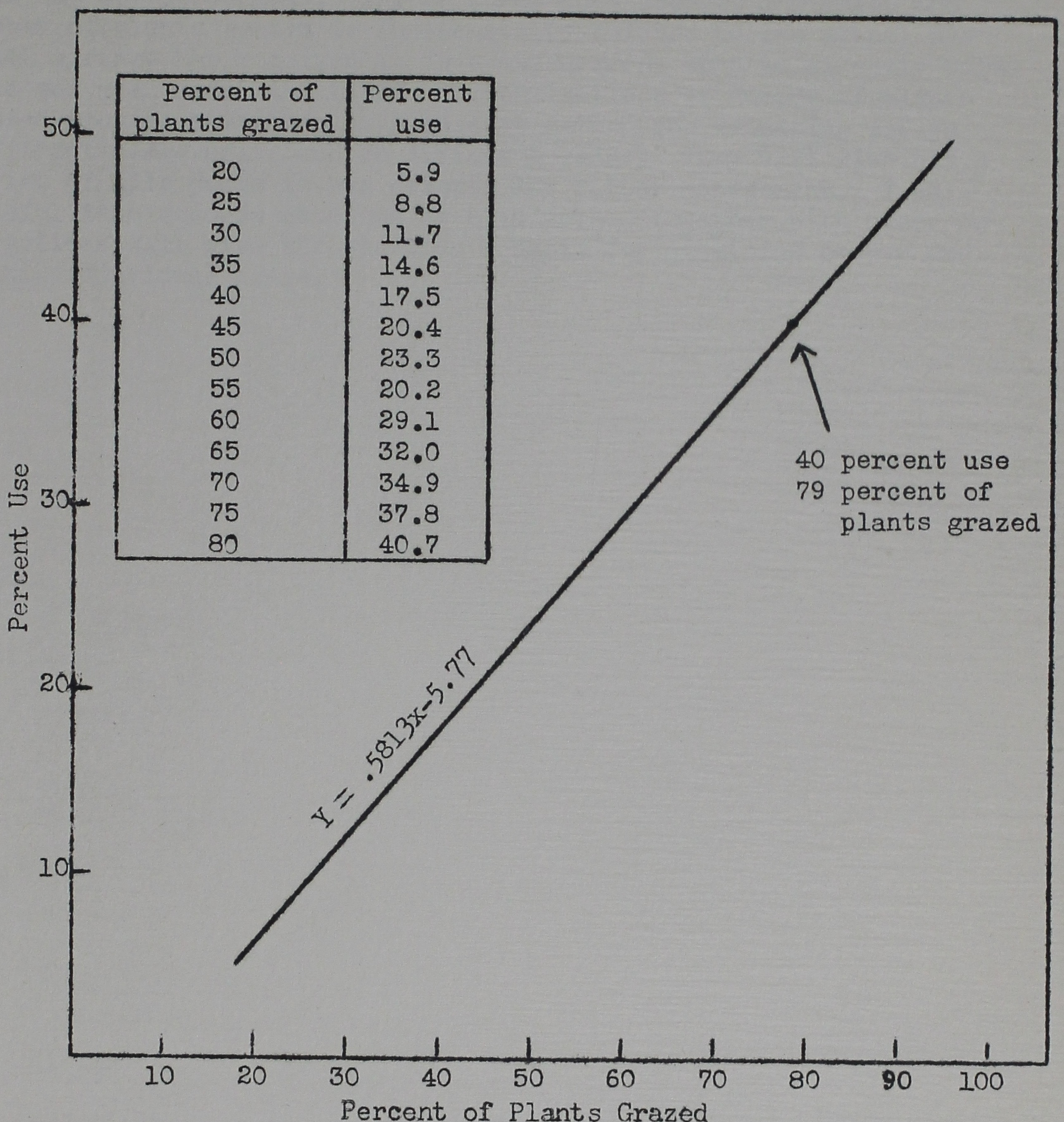
These observations indicate that the percentage of grass plants which are grazed or which have been left ungrazed at any time can provide a key to measurement of utilization. This factor is easy to measure. All that is necessary is to take 100 paces along a straight line through a range and at each pace record whether the plant nearest the toe is grazed or ungrazed. The result expresses directly the percentage of plants grazed. Only the palatable forage species are considered. It is, of course, necessary to take enough samples to get a reasonably accurate average for the portion of the range being evaluated. It is also necessary to use a representative area for measuring, and to avoid any bias in selection of the paced lines.

Statisticians have developed methods for insuring that sample measurements such as these are representative, unbiased, and numerous enough to give a reliable sample. I believe, however, that most stockmen can sample a range and will not be very far off if they use their own good judgment. Thus, if a pasture that showed heavy use in one end and light use in another were being sampled, it would be logical to divide the area into two or more zones and obtain an average figure for each zone. An average for the entire pasture, where use varied widely, would be much less valuable than a measure of use by zones. Also, if the measurement of the individual 100 pace lines varied greatly you would continue to make them until you had enough to give an average in which you had confidence. One would be satisfied with fewer determinations of percentage plants grazed if the measurements showed a good deal of consistency.

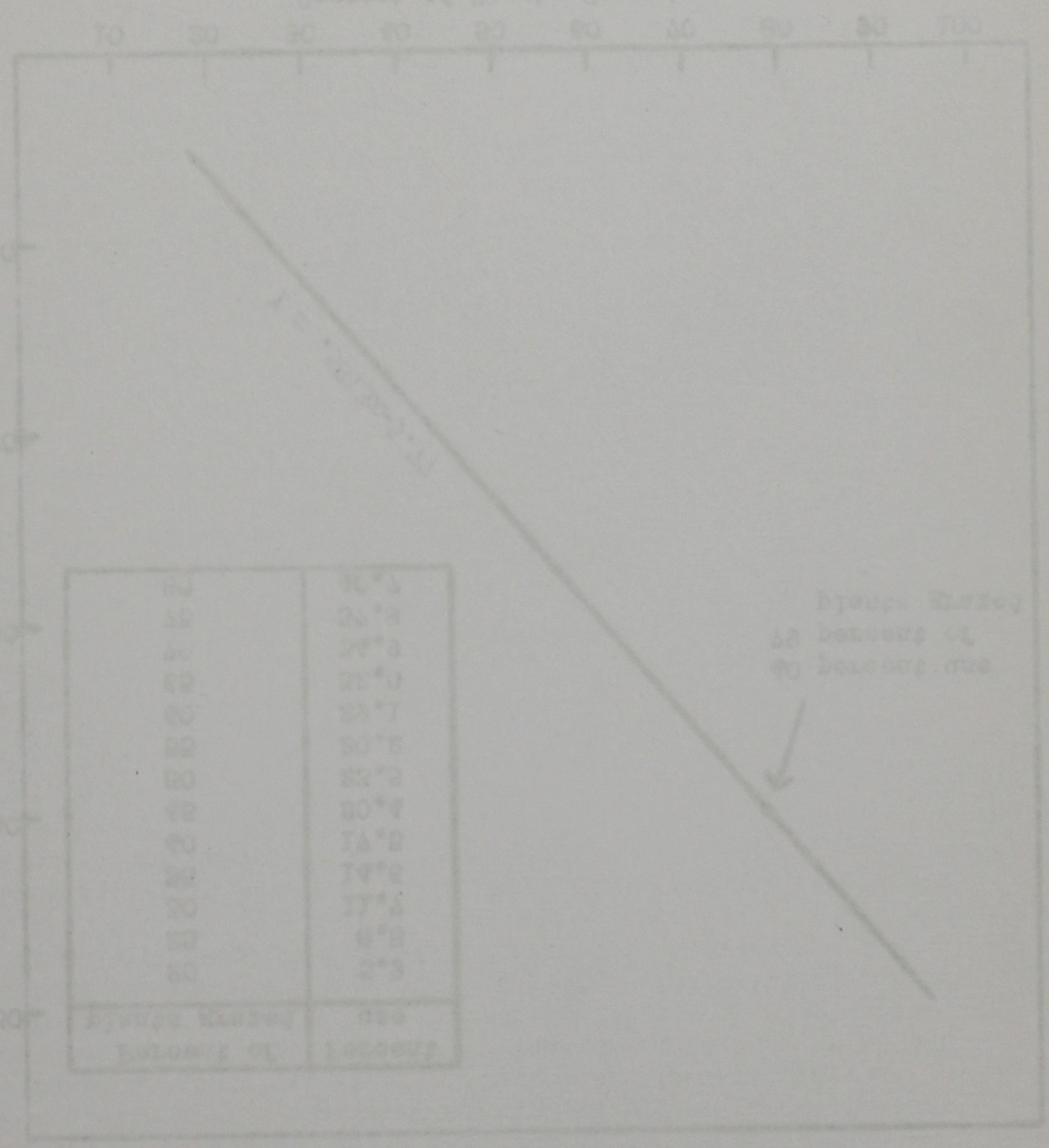
There are several important advantages in using the "percent of plants grazed" as a measure of utilization. The determination is simple, rapid, and can be made by almost anyone. Furthermore, it can be repeated and verified by others. About the only difficulty we have had in the operation of the method has been that occasionally it is difficult to decide whether or not a plant should be tallied as grazed. In some years, regrowth may mask earlier grazing. Under very light use especially early in the season, plants are sometimes "topped." Experience has indicated, however, that the differentiation can be made rather easily on grass ranges used moderately, and that while there is some difference in the height of the stubble of grazed plants, this can be ignored without materially influencing the accuracy of the result.

The final value of this method of judging utilization lies in the interpretation of the measurement of "percentage of plants" grazed after it has been determined. We have correlated such measurements with the weight of herbage that has been grazed on hundreds of samples. The results of this analysis indicate that there is a very consistent relationship on black grama range. On the basis of this relationship we find that 40 percent of the herbage has been taken and the range is about correctly utilized, when approximately 79 percent of the plants have been grazed. If the examination is made at the midpoint of the grazing season and shows that 44 percent of the plants are grazed, then it can be concluded that utilization has been about one-half of what is proper (20 percent of the herbage taken) and that the stocking rate is about right.

Percent of plants grazed	Percent use
20	5.9
25	8.8
30	11.7
35	14.6
40	17.5
45	20.4
50	23.3
55	20.2
60	29.1
65	32.0
70	34.9
75	37.8
80	40.7



Percent use as determined by weight of herbage removed, in relation to percent of black grama plants grazed. Based on data from Jornada Experimental Range.



The relationship between percentage of plants grazed and percentage of herbage taken varies from type to type. It has been determined for only a few conditions so that we cannot provide charts for determining proper use by counting the grazed plants on other ranges. This may not be serious. If, as these data seem to indicate, the number of plants grazed is fundamentally related to the actual use which a range has received it is a measurement that is directly valuable and meaningful in itself. Determinations of number of plants grazed provide a rancher with an easy method for comparing use on different range units and in different years. They will give him a series of mile posts in his efforts for better management. I am hopeful that records obtained by this method together with other observations will give the stockman a basis for attaining proper use on his individual range.

THE INFLUENCE OF WATER DISTRIBUTION ON THE GRAZING CAPACITY OF RANGE LAND

By K. A. Valentine

Perhaps one of the most common questions asked with respect to any range land is "What is its grazing capacity—How many head will it safely carry?" This is a most important question, for it is a well recognized fact that grazing animals have a marked adverse influence on range land if held on it in excessive numbers. It is also a direct and simple question and deserving of a simple answer. Yet it is not always possible to give a simple answer that is at the same time sufficiently accurate for all, or even the majority, of cases.

We are all aware of the fact that range land does have a limit to the number of grazing animals that it will carry without deterioration, although it must be admitted that generally this limit is not easily defined. If stocking consistently exceeds this limit, pasture deterioration occurs, at a rapid rate if the excess is great and at a slow rate if slight. We also realize that range forage is valuable, supporting the production of large quantities of animal products. Further, it costs to use or own it, either in the form of leases, fees, or interest, taxes and depreciation, and these costs must be offset by productive use of the range. For these reasons, we recognize that it is desirable to make as full use as possible of range land, at the same time avoiding the excessive use which we know would bring about deterioration.

To obtain full grazing use of range land and avoid damaging overuse requires that we take into consideration all factors that influence its grazing capacity. The more closely we approach full grazing use, the more carefully we must consider the influencing factors and the more we must refine our concepts and methods of applying them.

Now in our attempts to arrive at correct grazing of range land, we have focused our attention on vegetation. This is perhaps as it should be for it is just good common sense. We know that good stands of good palatable vegetation have high grazing capacity, poor stands of inferior vegetation have low capacity, and that the various combinations of these two extreme conditions yield intermediate grazing capacity values. We have not, however, considered all important factors that influence grazing capacity until we consider how the range vegetation is used by grazing animals and what influences this use. This brings us to a consideration of the influence of water distribution on grazing capacity.

It is obvious that without some kind of water for livestock, either natural or artificially developed, range land has no real or effective grazing capacity, regardless of how good the vegetation cover is nor how choice the species that make it up. It is only in combination with water that range land may be considered to have effective grazing capacity. This, of course, is a well known fact.

It is not correct, however, to consider that water on range land, whether natural or artificial, renders all the range land it serves of equal grazing value, even though vegetation and forage production may be uniform throughout the area. This is particularly true with respect to much western range land, where water is scarce and expensive to develop. Here natural water, wells, and tanks are limited in number and relatively widespread. Consequently, there is a large proportion of the range that lies at considerable distance from water. These outlying areas are less accessible to grazing animals than areas closer in to water developments, they receive less use and contribute less to grazing capacity on a unit area basis than areas lying closer to water.

If we are to stock pastures in accordance with their grazing capacities, we must recognize that differences in capacity due to differences in degree or intensity of water development do exist. Small pastures and pastures which have sufficient watering places to make all or most of the area easily accessible to water have higher, and sometimes considerably higher, capacities per unit of area than large pastures with watering places appreciably more widely spaced.

This difference in stocking rate due to difference in intensity of water development is well illustrated by records from three of our pastures at this location. These pastures are for the most part fairly comparable so far as topography, soil, and vegetation are concerned. The chief difference is the intensity of water development and grazing use. Pertinent data from these pastures are summarized in the following table:

	Pasture #1	Pasture #4	Pasture #5
Vegetation	Good black grama grassland		
Actual stocking rate, A.U. yrs./sec.	6.3	7.3	8.6
Full stocking rate, A.U. yrs./sec.	8-9	10-11	13-14
Area, Sections	3.81	1.37	1.00
Distance from water:			
0 - ½ mile	11%	26%	70%
½ - 1 mile	20%	39%	30%
1 - 1½ miles	27%	28%	0
1½ - 2 miles	30%	7%	0
2 - 2½ miles	12%	0	0
Proper use of vegetation, average for pasture, percent	27	34	47

It will be seen that there are rather considerable differences in actual stocking rates between these pastures and also in the full stocking rates computed from the actual stocking. These are explained by the fact that all of Pasture 5 is well within a mile from water

where it properly receives nearly full use and supports a comparatively large grazing load. On the other hand, only 31 percent of Pasture 1 is within one mile from water where it can receive nearly full use and support a large grazing load. The other 69 percent of the pasture is more than a mile from water and in consequence is moderately to lightly used, and supports a moderate to light grazing load. The grazing rates per section for Pasture 1, coming from areas of high and low values are necessarily lower than the rates for Pasture 5, the entire area of which is of high value. Pasture 4 is intermediate, between 1 and 5, with respect to distance from water and consequently is intermediate in actual and full stocking rates. The full proper use for these pastures, an average of full and some less than full use in each, is 27, 34, and 47 percent of vegetation for Pasture 1, 4, and 5 respectively.

It may seem wasteful of forage to regard a pasture as being properly used when a considerable portion of it is moderately used and some even lightly used. This is true only if excessive areas are too lightly used. Actually, accepting moderate and light use of outlying pasture area is only being realistic about the natural and inevitable grazing habits of livestock and their effects on the range. If the natural tendency of grazing animals to use outlying areas more lightly than easily accessible areas is disregarded in an attempt to increase use of outlying areas, the result is to obtain damaging use on the more accessible areas and to sustain a permanent, or at least long time, loss of forage. The gain in increased use of outlying area may be offset, or more than offset, by destruction of the more accessible vegetation.

This is illustrated by yield data from two areas which have been subjected to very different degrees of use in the past. Area "A" has received use varying from near-full use on the easily accessible area near water, to light use on outlying area.

Area "B" has received about full use at a distance of 2 miles from water. The range between the full use area and water has received various degrees of use, from heavy to extremely heavy, with the result that all this large area has a poor cover on it and produces only about half the forage produced on the corresponding range surrounding water on Area "A".

Distance from water (Miles)	Area "A" (lbs/acre)	Area "B" (lbs/acre)
0 - 1/2	240	65
1/2 - 1	308	118
1 - 1-1/2	280	120
1-1/2 - 2	286	167
2 - 2-1/2	473	397
Average	307	162

Distance from motor	"A" flow	"B" flow

This matter of appreciably less than full proper use of vegetation on outlying areas is a very real problem in the management of range land but its correct solution is not simply stocking to a level that will force full utilization of forage on these areas. All methods that will bring about distribution of livestock should, of course, be put into practice. Providing as much water as is economically feasible is one of the best methods of bringing about more even distribution. The feeding salt-meal mixture on outlying areas gives promise of being a good method of improving distribution. But is is probable that any and all methods will still fall short of bringing all of this type range land under essentially uniform grazing use. This means that we will always have to regard something less than full use as proper on such range land and recognize that a single stocking rate cannot be regarded as proper even under essentially uniform conditions with respect to range vegetation.

THE INFLUENCE OF SIRES ON THE PRODUCTION OF THEIR DAUGHTERS

By Marvin Koger

One of the essentials of profitable range cattle operations is to have the breeding herd made up of cows that breed regularly and have the "mothering" qualities which enable them to raise their calves to heavy weaning weights. A cow that meets these requirements under range conditions performs a feat that is a credit to herself, a source of profit to her owner, and a much needed contribution to an ever-dwindling per-capita beef supply. The selection of replacement heifers that will develop into cows excelling in these qualities is a matter of importance to cattle producers only second to good management or possibly to none, from a long range point of view.

It is a well known fact that the best replacements for a breeding herd are the best heifers from good mothers. Data from this ranch, however, show that a bull may transmit breeding and "mothering" qualities to his daughters which do not become evident until they come into production. The purpose of this discussion is to point out the differences which we have observed in the production of cows by different bulls, and to indicate what we feel is the best insurance against keeping replacements that will prove disappointing.

Our records of the life-time get of 23 bulls which have been most extensively used on the College Ranch, show that the difference in production (based on weaning weight of calves) of daughters by different sires was greater than the differences between calves sired by different bulls. The maximum difference in average weaning weights of calves sired by different bulls was 47 pounds, while the greatest difference in production of daughters by these sires was 84 pounds.

The average production of the best sire group shown in the demonstration on Ranch Day was 454 pounds, and that of the poorer was 428 pounds. The average weaning weights of all calves sired by the two bulls was 431 and 437 pounds, respectively. Thus, while there was no significant difference in weaning weight of calves sired by the two bulls, there was a significant difference in weaning weights of calves produced by their daughters. The daughters of one bull had inherited, through their sire, a better suckling ability than the other group had. This was the reason for the higher weaning weights of their calves. Records on the production capacity of a bull's daughters are not available soon enough to be of much value in determining how much to use a bull. How, then, can one proceed with some assurance that a bull's daughters will be good producers? While this assurance may never be achieved fully, heritability studies (unpublished) made at the College indicate that the best method is to use only bulls from dams that produce thrifty, heavy calves. In other words, a bull should not be selected on type alone, but also on demonstrated good suckling ability of his dam. Since bulls can not be judged on the

production of their daughters until late in life, about the only way we have to make the bull contribute to the "mothering" qualities of his daughters is to select him on the basis of his dam's "mothering" ability. Replacement heifers out of good productive cows and sired by bulls with good dams will, on the average, be good producers. Unless some attention is paid to bulls, they may reduce production of their female offspring more than can be offset by selection on the dam's side.